Net photosynthesis rate and chlorophyll content of Caucasian and white clover leaves under different temperature regimes.

Conclusions

- Higher net photosynthesis rates (Pn) for Caucasian clover (Cc) leaves were attributed to their higher chlorophyll content than white clover (wc).
- Thus, for any given canopy leaf area index, Cc canopy Pn is expected to exceed that for wc and give more assimilate per unit leaf area.
- This could explain higher growth rates for Cc over wc observed in intensive temperate pastures.

Background

- Caucasian or Kura clover (Trifolium ambiguum) was more productive than white clover (T. repens) in New Zealand pastures.
- Examining the physiological basis for this difference can provide greater insight into the suitability of Cc for inclusion in temperate pastures.
- Leaf photosynthesis rate drives seasonal growth and is regulated by temperature and chlorophyll content.
- Thus, Pn and chlorophyll content of Cc and wc leaves were compared under different temperature regimes.

Methods

- Cc and wc were grown under irrigation at Lincoln University, Canterbury, New Zealand.
- Pn and chlorophyll were measured at either 12 °C (Tmin) or 23 °C (Tmax) air temperatures.
- Pn was measured on 10 leaves at 7 light intensities using a photosynthesis system (LI-6400 LiCor).
- Chlorophyll content was estimated using a chlorophyll meter (SPAD-502 Minolta).

Results

- Pn responses to light intensity followed non-rectangular hyperbolas (Figure 1).
- Cc $P_{n_{\text{max}}}$ was 32 μmol CO$_2$/m$^2$/s at 23 °C but decreased to 17 μmol CO$_2$/m$^2$/s at 12 °C.
- These rates were ~6 μmol CO$_2$/m$^2$/s higher than wc $P_{n_{\text{max}}}$.
- Chlorophyll contents were higher for Cc than wc at both temperatures (Table 1).

![Figure 1. Pn response to light intensity at either 12 °C (Tmin) or 23 °C (Tmax). Bars indicate se for $P_{n_{\text{max}}}$](image)

<table>
<thead>
<tr>
<th>Chlorophyll</th>
<th>$T_{\text{min}}$</th>
<th>$T_{\text{max}}$</th>
<th>$P_{n_{\text{max}}}$ (μmol CO$_2$/m$^2$/s)</th>
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<tbody>
<tr>
<td>Cc</td>
<td>2.01</td>
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<td>wc</td>
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<td>1.74</td>
<td>26.00</td>
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<td>Chlorophyll B</td>
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<td>0.29</td>
<td>0.50</td>
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<td>Total chlorophyll</td>
<td>2.33</td>
<td>2.09</td>
<td>32.50</td>
<td>0.044</td>
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</tbody>
</table>

Table 1. Chlorophyll contents (mg/g) for Cc and wc at 12 °C and 23 °C.